Estimation of Vessel Loading

and other research activities presently underway in support of IWR NETS

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Overview

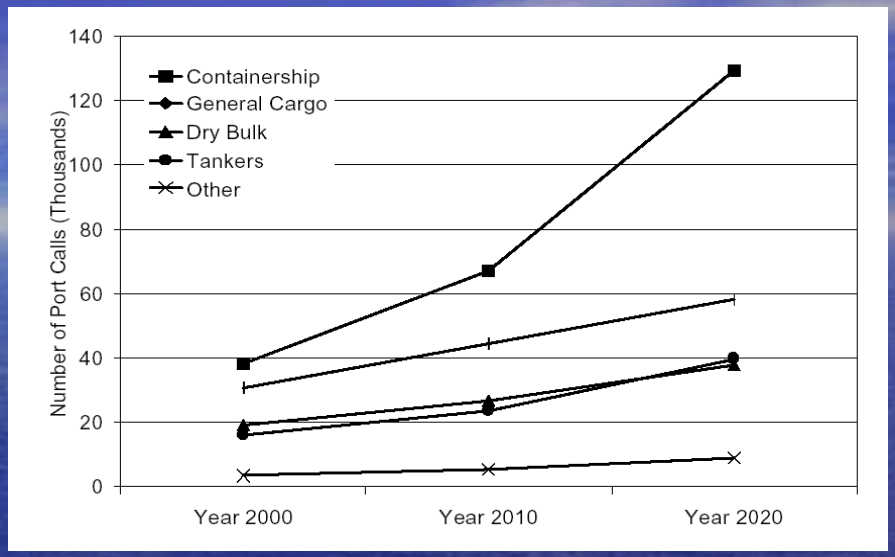
- Background
- Current Activities
- Outcomes and Applications of Findings
- Products and Conclusions
- Discussion and Questions

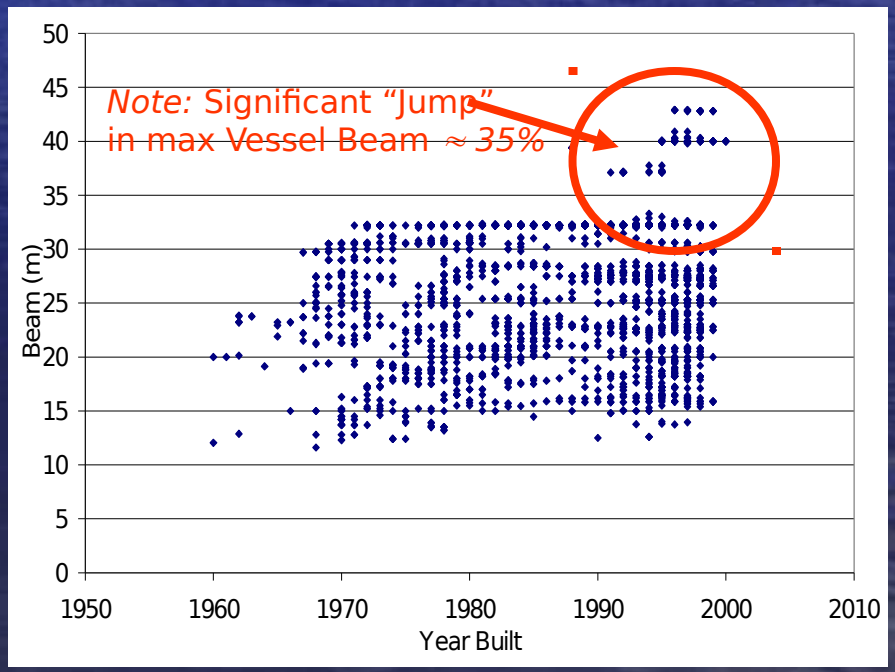
Background

- Previous Work
  - Navigation Trends Work Unit
  - Shipping Trends work unit looked at gross-scale changes in vessel trends
- Current Work
  - Part of IWR's Navigation Economic Analysis Technologies (NETS) program
  - Investigate details of vessel loading
  - Incorporate anticipated trends
  - Use additional tools to assess economic and logistical impacts to shipping

Previous Findings

- Numbers of Vessel Calls on U.S. ports will increase
- Vessel dimensions are increasing, but disproportionately:
  - B increasing fastest
  - T increasing slowly





Vessels are Coming and Vessels are Changing …

- How will these *changing vessels* impact *navigation channel design*?
- How will these changes affect *vessel operations*?
- What are the *economic* considerations and concerns?

Current Activities

- Investigation of detailed loading issues
  - Containers and containerships
  - Loading software
  - Actual manifests
- Investigation of detailed vessel characteristics
  - Beyond L,B,DWT
  - Detailed external and internal configuration changes
- Investigation of off-design vessel operation impacts to vessel powering

Evaluation of Vessel Loading Software

- Several software packages used by shippers and ship owners were evaluated for use in this study
- Intent: Use software to assist in the detailed analysis of vessel loading trends
  - Departure, In-transit & Arrival conditions
  - Resulting differences in stability and other vessel parameters
  - Applications to route optimization

Software Considered for Evaluation

- Autoload
- CargoMax
- CyberMaster
- GHSLM
- Loadstar
- MXMACS3+Belco
- NAPA/Onboard NAPA
- Powerstow

Evaluation Criteria

- Price
- Features
- User Interface
- Existing Clients
- Availability of Models
- Other Issues (e.g., port optimization)

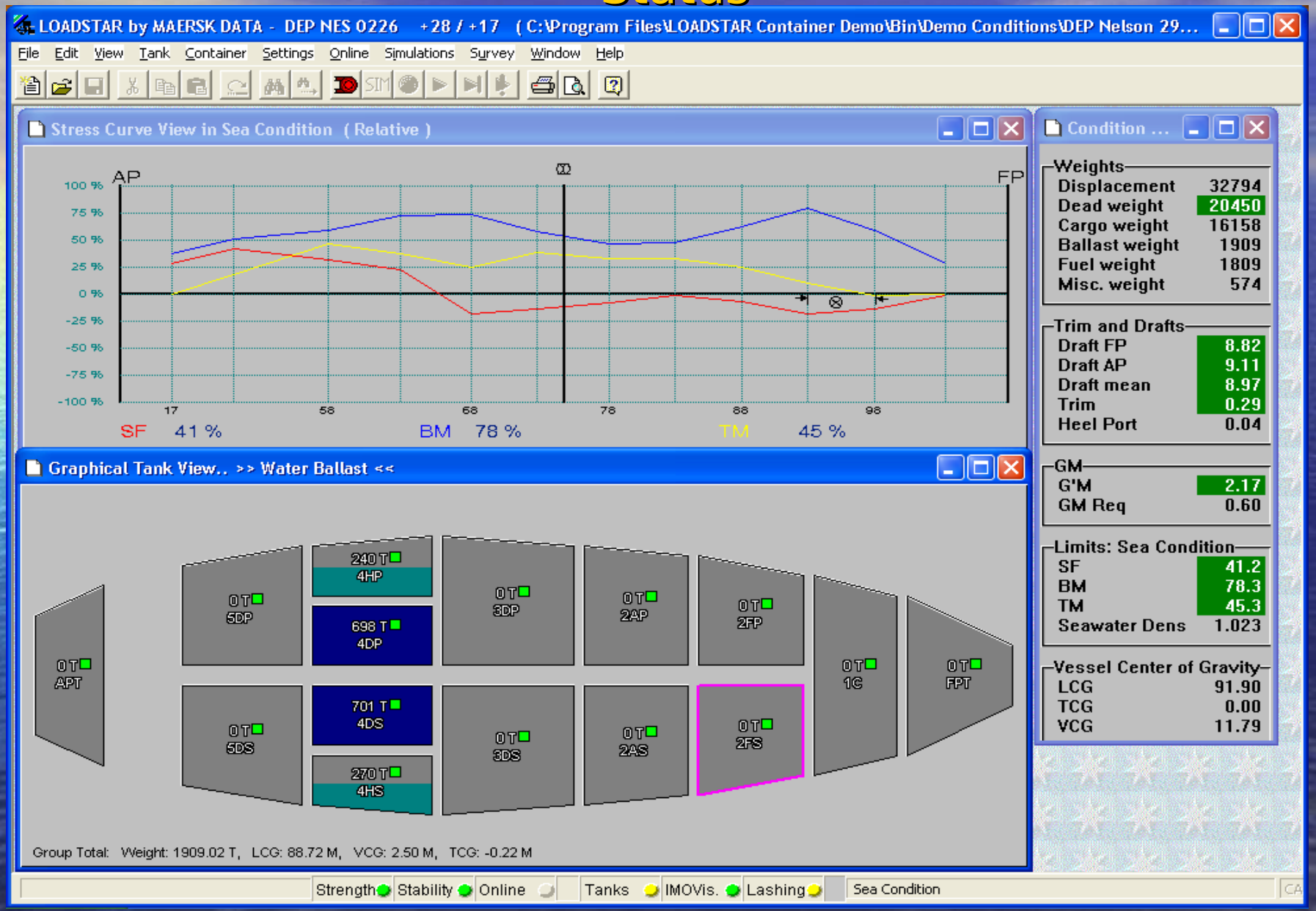
Selection/ Outcome of Software to be Employed in Further Analysis

- Maersk Loadstar
- NAVIS PowerStow
- Others:
  - AutoLoad
  - Onboard NAPA

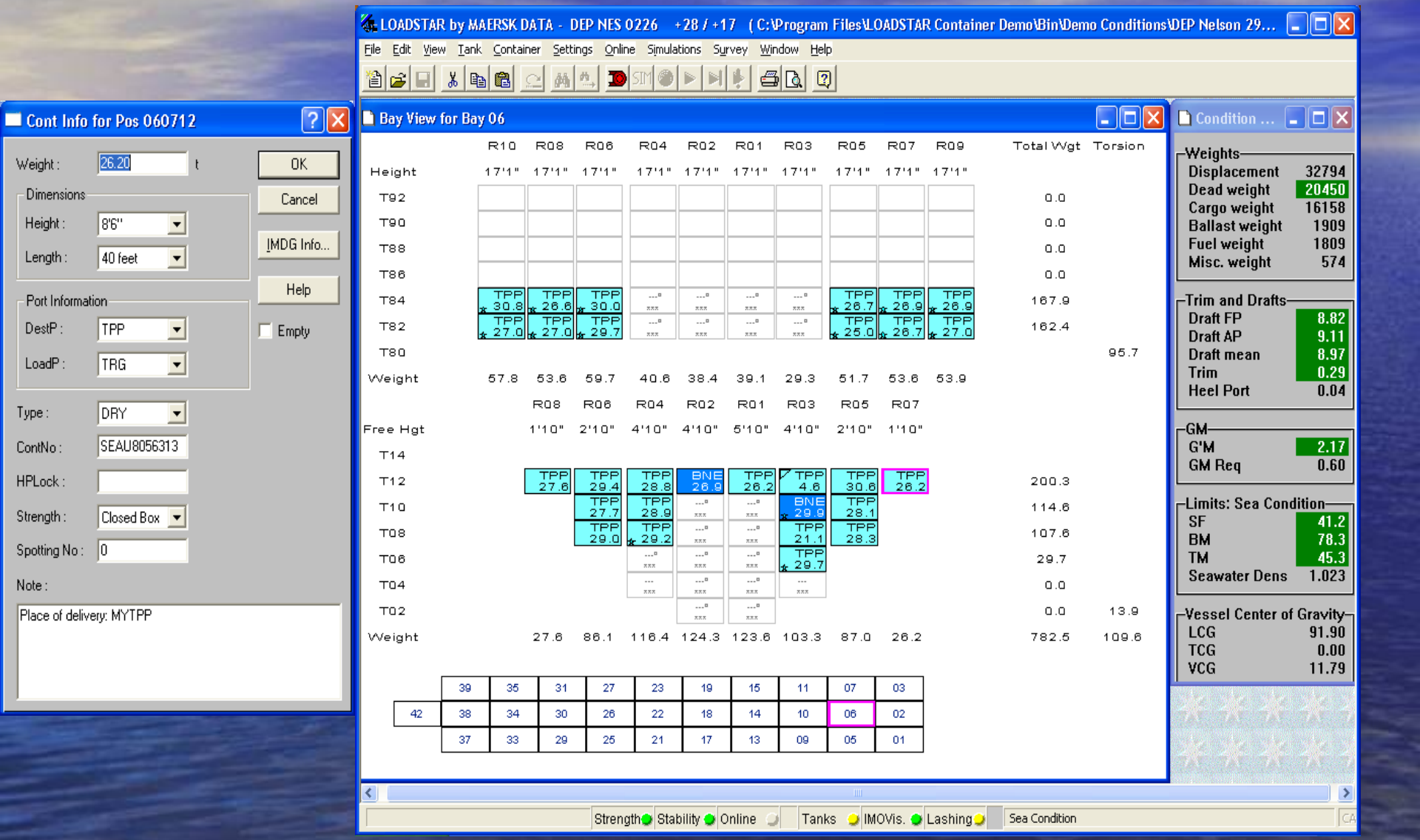
Loading Software Capabilities

- Intact stability and stress calculations
- Calculation of maximum strength levels in relation to permissibles
- Graphical illustration of GZ curves
- Draft, trim and heel calculations
- Optimizes loading and unloading of the vessel
- Input of cargo and ballast

Graphical Tank View, Stress Curves and Condition Status

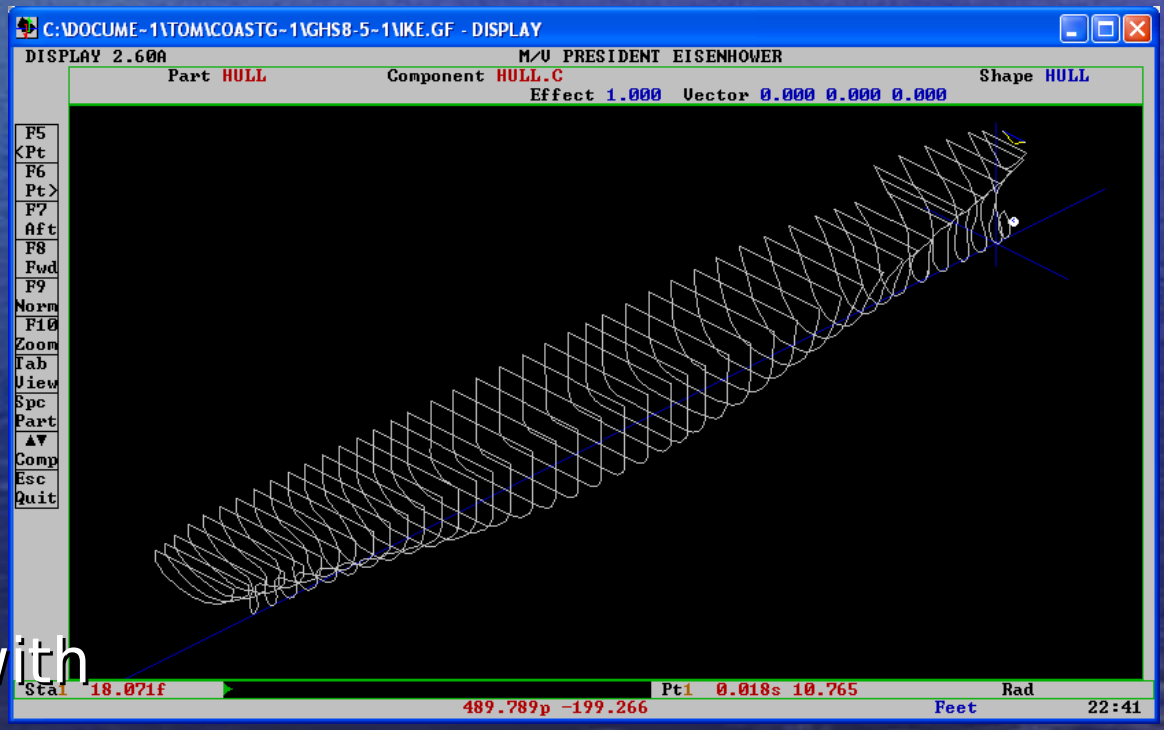


Loadstar Container Details and Bay View

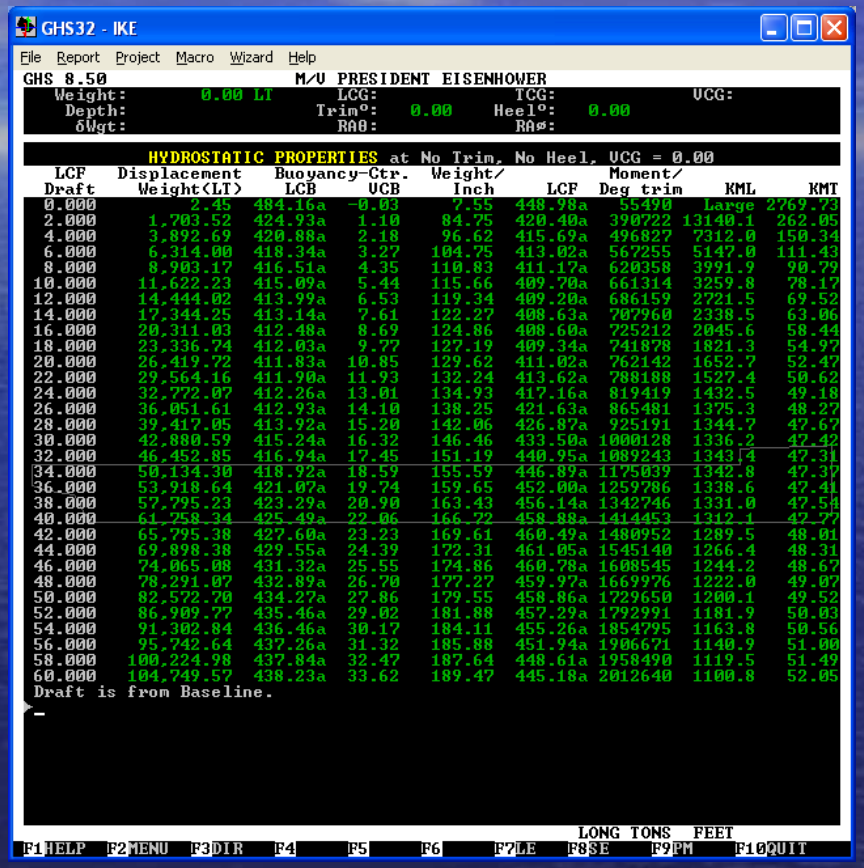

Cont Info for Pos 060712
Weight : 26.20 t
OK
Cancel
IMDG Info...
Help
Empty
Dimensions
Height : 8'6"
Length : 40 feet
Port Information
DestP : TPP
LoadP : TRG
Type : DRY
ContNo : SEAU8056313
HPLock :
Strength : Closed Box
Spotting No : 0
Note :
Place of delivery: MYTPP
LOADSTAR by MAERSK DATA - DEP NES 0226 +28 / +17 (C:\Program Files\LOADSTAR Container Demo\Bin\Demo Conditions\DEP Nelson 29...
File Edit View Tank Container Settings Online Simulations Survey Window Help
Bay View for Bay 06
R10 R08 R06 R04 R02 R01 R03 R05 R07 R09 Total Wgt Torsion
Height 17'1" 17'1" 17'1" 17'1" 17'1" 17'1" 17'1" 17'1" 17'1" 17'1"
T92 0.0
T90 0.0
T88 0.0
T86 0.0
T84 TPP 30.8 TPP 26.6 TPP 30.0 TPP 26.7 TPP 26.9 TPP 26.9 167.9
T82 TPP 27.0 TPP 27.0 TPP 29.7 TPP 25.0 TPP 26.7 TPP 27.0 162.4
T80 95.7
Weight 57.8 53.6 59.7 40.6 38.4 39.1 29.3 51.7 53.6 53.9
R08 R06 R04 R02 R01 R03 R05 R07
Free Hgt 1'10" 2'10" 4'10" 4'10" 5'10" 4'10" 2'10" 1'10"
T14
T12 TPP 27.6 TPP 29.4 TPP 28.8 BNE 26.9 TPP 26.2 TPP 4.6 TPP 30.6 TPP 26.2 200.3
T10 TPP 27.7 TPP 28.9 BNE 29.9 TPP 28.1 114.6
T08 TPP 29.0 TPP 29.2 TPP 21.1 TPP 28.3 107.6
T06 TPP 29.7 29.7
T04 0.0
T02 0.0 13.9
Weight 27.6 86.1 116.4 124.3 123.6 103.3 87.0 26.2 782.5 109.6
39 35 31 27 23 19 15 11 07 03
42 38 34 30 26 22 18 14 10 06 02
37 33 29 25 21 17 13 09 05 01
Condition ...
Weights
Displacement 32794
Dead weight 20450
Cargo weight 16158
Ballast weight 1909
Fuel weight 1809
Misc. weight 574
Trim and Drafts
Draft FP 8.82
Draft AP 9.11
Draft mean 8.97
Trim 0.29
Heel Port 0.04
GM
G'M 2.17
GM Req 0.60
Limits: Sea Condition
SF 41.2
BM 78.3
TM 45.3
Seawater Dens 1.023
Vessel Center of Gravity
LCG 91.90
TCG 0.00
VCG 11.79
Strength Stability Online Tanks IMOVis. Lashing Sea Condition

Investigation of Detailed Vessel Characteristics

- Analysis of lines drawings and general arrangements
- Vessel types
  - Containerships
  - Tankers
  - Bulkers
  - RO/ROs
  - General Cargo
  - Liq. Gas
  - Passenger
- In coordination with
  - USCG, MARAD, ABS, Lloyd's

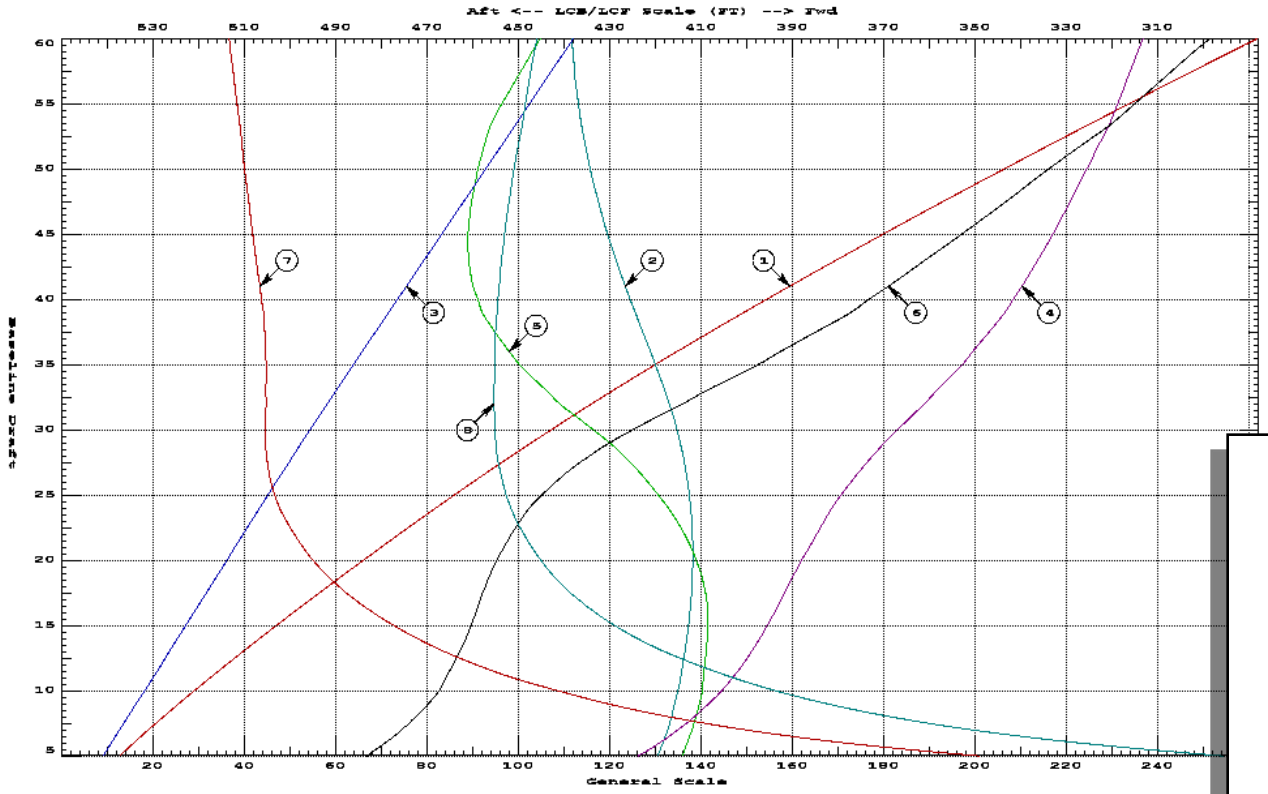


- Analysis using industry-standard General Hydrostatics Software (GHS)
- Numerous parameters calculated
  - Level trim
  - Variable trim effects on parameters



HYDROSTATIC PROPERTIES at LEVEL TRIM

GHS 8.50 M/V PRESIDENT



1. Displacement 1=400 LT
2. LCB (use top scale)
3. VCB (KB) 1=.3 FT
4. Immersion 1=.8 LT/IN
4. WPA 1=336 Sq.FT
5. LCF (use top scale)
6. Moment/Trim 1=8000 FT-
7. KML 1=30 FT
8. KMT 1=.5 FT

Specific Gravity = 1.025 Assumed KG = 0.00 FT
"K" = Baseline

04-04-04 22:41:24 USCG - MSC, Washington, D.C. Page 5
GHS 8.50 M/V PRESIDENT EISENHOWER

HYDROSTATIC PROPERTIES
No Trim, No Heel, VCG = 0.00

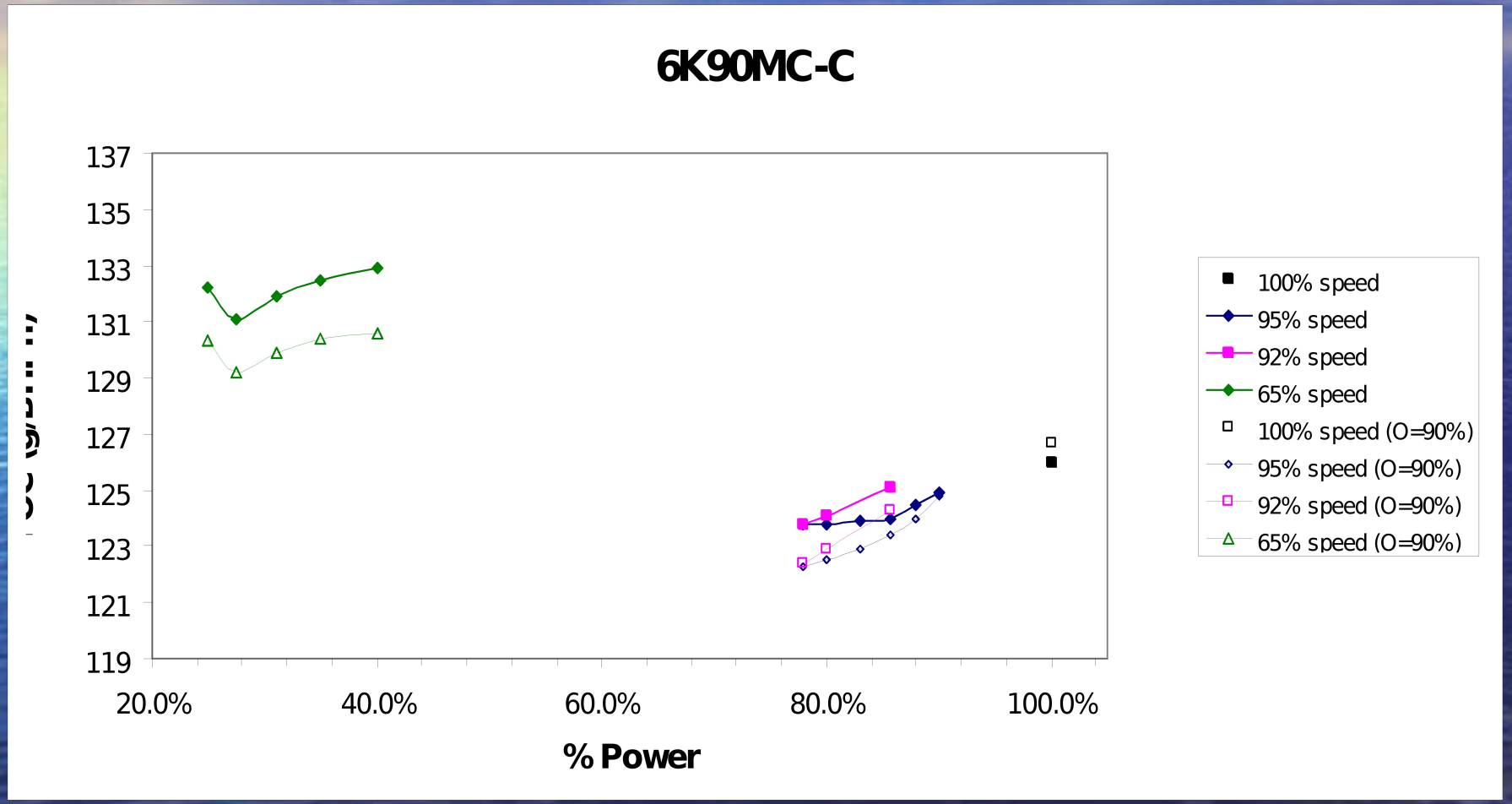
LCF Draft	Displacement Weight(LT)	Buoyancy-Ctr. LCB	VCB	Weight/ Inch	LCF	Moment/ Deg trim	KML	KMT
5.000	5,079.05	419.49a	2.72	101.00	414.14a	534768	6032.0	127.17
6.000	6,314.00	418.34a	3.27	104.75	413.02a	567255	5147.0	111.43
7.000	7,590.37	417.36a	3.81	107.97	411.99a	595533	4494.9	99.65
8.000	8,903.17	416.51a	4.35	110.83	411.17a	620958	3991.9	90.79
9.000	10,248.13	415.77a	4.90	113.36	410.36a	642030	3589.1	83.79
10.000	11,622.23	415.09a	5.44	115.66	409.70a	661314	3259.8	78.17
11.000	13,022.12	414.49a	5.99	117.60	409.57a	673195	2961.7	73.54
12.000	14,444.02	413.99a	6.53	119.34	409.20a	686159	2721.5	69.52
13.000	15,885.32	413.54a	7.07	120.85	408.90a	697487	2515.5	66.01
14.000	17,344.25	413.14a	7.61	122.27	408.63a	707960	2338.5	63.06
15.000	18,819.80	412.78a	8.15	123.60	408.54a	717035	2182.7	60.56
16.000	20,311.03	412.48a	8.69	124.86	408.60a	725212	2045.6	58.44
17.000	21,816.87	412.23a	9.23	126.02	408.81a	733133	1925.2	56.57
18.000	23,336.74	412.03a	9.77	127.19	409.34a	741878	1821.3	54.97
19.000	24,870.88	411.90a	10.31	128.36	410.04a	751067	1730.1	53.60
20.000	26,419.72	411.83a	10.85	129.62	411.02a	762142	1652.7	52.47
21.000	27,984.11	411.83a	11.39	130.94	412.21a	774926	1586.5	51.49
22.000	29,564.16	411.90a	11.93	132.24	413.62a	788188	1527.4	50.62
23.000	31,159.98	412.05a	12.47	133.55	415.28a	803075	1476.5	49.83
24.000	32,772.07	412.26a	13.01	134.93	417.16a	819419	1432.5	49.18
25.000	34,401.81	412.56a	13.55	136.53	419.31a	841014	1400.6	48.67
26.000	36,051.61	412.93a	14.10	138.25	421.63a	865481	1375.3	48.27
27.000	37,722.83	413.38a	14.65	140.09	424.09a	893997	1356.8	47.94
28.000	39,417.05	413.92a	15.20	142.06	426.87a	925191	1344.7	47.67
29.000	41,135.61	414.53a	15.76	144.16	429.95a	960130	1337.2	47.50
30.000	42,880.59	415.24a	16.32	146.46	433.50a	1000128	1336.2	47.42
31.000	44,651.97	416.04a	16.88	148.81	437.22a	1043274	1338.6	47.36
32.000	46,452.85	416.94a	17.45	151.19	440.95a	1089243	1343.4	47.31
33.000	48,280.57	417.91a	18.02	153.32	443.77a	1129600	1340.4	47.32
34.000	50,134.30	418.92a	18.59	155.59	446.89a	1175039	1342.8	47.37
35.000	52,014.54	419.99a	19.17	157.76	449.75a	1220466	1344.2	47.39
36.000	53,918.64	421.07a	19.74	159.65	452.00a	1259786	1338.6	47.41
37.000	55,845.59	422.18a	20.32	161.53	454.11a	1300614	1334.3	47.46
38.000	57,795.23	423.29a	20.90	163.43	456.14a	1342746	1331.0	47.54
39.000	59,767.45	424.40a	21.48	165.25	457.92a	1383244	1325.9	47.65
40.000	61,758.34	425.49a	22.06	166.72	458.88a	1414453	1312.1	47.77
41.000	63,768.19	426.56a	22.64	168.23	459.92a	1448814	1301.6	47.89
42.000	65,795.38	427.60a	23.23	169.61	460.49a	1480952	1289.5	48.01
43.000	67,838.79	428.60a	23.81	170.95	460.87a	1512654	1277.4	48.15
44.000	69,898.38	429.55a	24.39	172.31	461.05a	1545140	1266.4	48.31
45.000	71,974.09	430.46a	24.97	173.62	461.02a	1577172	1255.4	48.49
46.000	74,065.08	431.32a	25.55	174.86	460.78a	1608545	1244.2	48.67
47.000	76,170.84	432.13a	26.13	176.10	460.43a	1639884	1233.4	48.87
48.000	78,291.07	432.89a	26.70	177.27	459.97a	1669976	1222.0	49.07
49.000	80,425.04	433.60a	27.28	178.40	459.44a	1699450	1210.6	49.29
50.000	82,572.70	434.27a	27.86	179.55	458.85a	1729650	1200.1	49.52
51.000	84,734.20	434.89a	28.44	180.71	458.09a	1761083	1190.7	49.77
52.000	86,909.77	435.46a	29.02	181.88	457.29a	1792991	1181.9	50.03
53.000	89,099.46	435.98a	29.59	183.07	456.45a	1825391	1173.7	50.32
54.000	91,302.84	436.46a	30.17	184.11	455.26a	1854795	1163.8	50.56

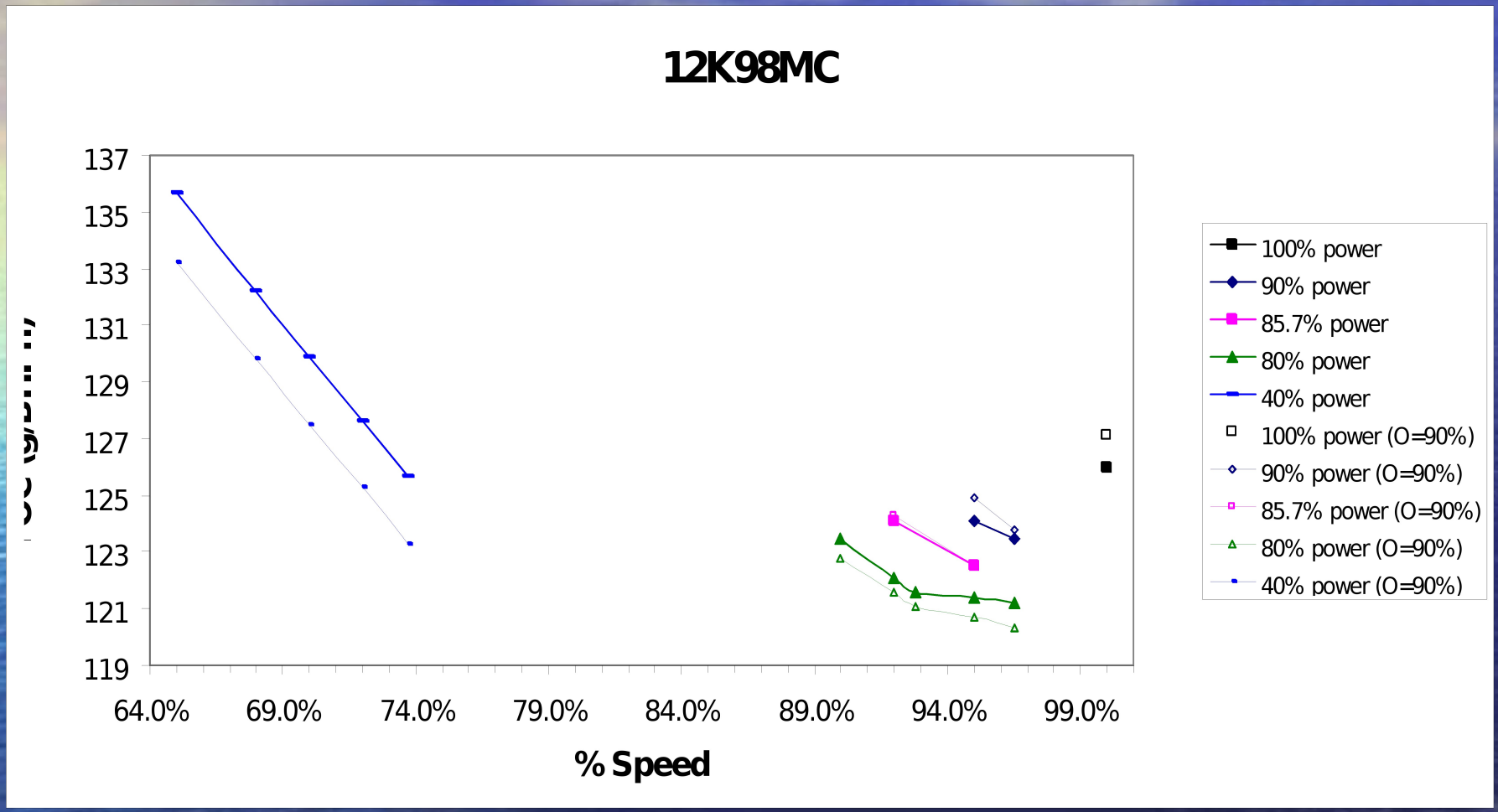
- Parametric analyses of immersion characteristics for different vessel types
  - Variation of these parameters with draft and loading configuration
  - Will be used in coordination with and compared to loading software analyses
- Updated vessel-specific data well beyond L, B, DWT

Investigation of Fuel Consumption in Off-Design Conditions

- Restricted Waterways
  - Slower Speed
  - Increased Power
  - Higher Power Loading
- Open Ocean
  - Sea State Considerations
  - Speed variations

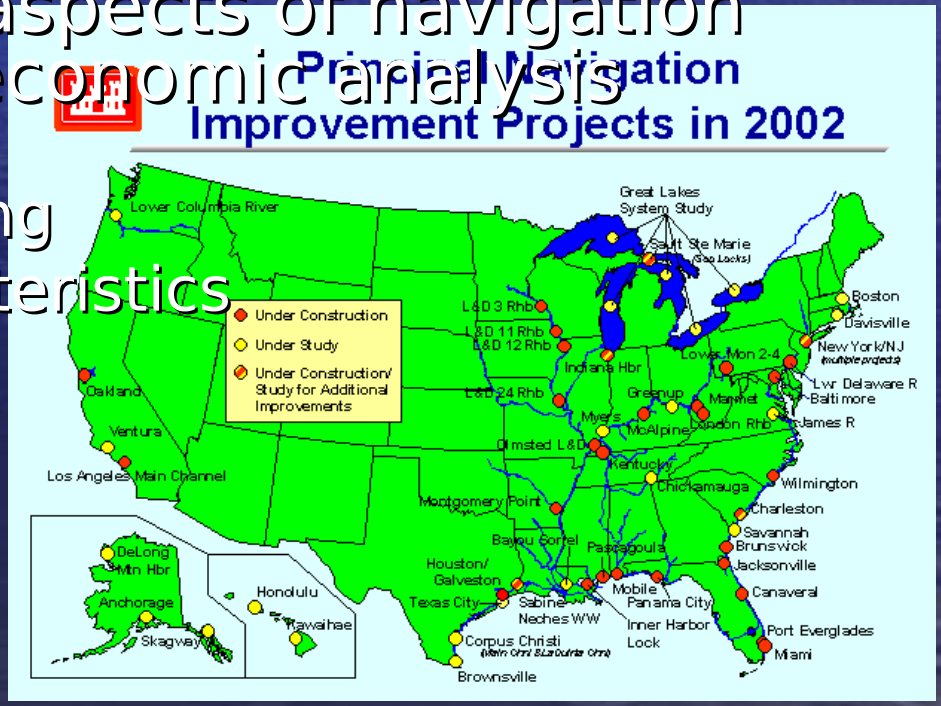
Sample Findings ...




12K98MC
137
135
133
131
129
127
125
123
121
119
64.0%
69.0%
74.0%
79.0%
84.0%
89.0%
94.0%
99.0%
% Speed
100% power
90% power
85.7% power
80% power
40% power
100% power (O=90%)
90% power (O=90%)
85.7% power (O=90%)
80% power (O=90%)
40% power (O=90%)

Outcomes/Conclusions

- Engineers, planners, economists need details
- Findings from these studies will have application to many aspects of navigation channel design and economic analysis
  - Loading software applications to planning
  - Refined vessel characteristics to economics
  - Vessel operations, fuel consumption to economics



- Reports and Papers
  - A Review of Maritime Container Box Physical, Economic and Life-Cycle Statistics
  - An Analysis of Vessel Loading and Stability Software
  - *A Detailed Analysis of Present and Future Vessel Characteristics*
  - *The Effect of Off-Design Vessel Operation on Powering and Specific Fuel Consumption (SFC)*
  - *Others in Preparation*

Discussion? Questions?

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